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Conceptual Problems

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A systems theory approach to information requirements in education and in evaluation strategies is applied to decision making. Educational decision making itself involves long range planning, system structuring to implement goals, system allocation (cost), and system monitoring which provides the feedback. Each level requires differential information about such classification areas as curriculum, pupil, staff, finance, facility, and community. For the evaluation process a methodology is proposed that meets information needs by providing (1) data elements based on a common definition of each category, (2) a "picture of the relationships between data content across classification areas," (3) information on multiple questions across these areas, and (4) alternatives of cost, practice, and procedure. This theoretical structure is applied to both the evaluative and the decision-making process in educational programs. (NH)

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Division D

Conceptual Problems

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Since a concept is a general idea about how things should be, I will confine my portion of this symposium to that topic. I hope that Joe Froomkin will be helpful in showing the problems he has encountered in trying to make things as they should be. Then we will move to the state level where Bill Miller will be able to present his view of things as they are in contrast to how they should be and finally, Jim Maxey will present some of the problems he encountered while attempting our first go-around at a statistical analysis of Title I data.

This portion will center on information requirements as defined by the several levels of educational decision making, the process of information gathering, information structuring, information display alternatives and information sources in an attempt to present a workable evaluation conceptual paradigm. The changes in information needs at the various levels of educational decision making and the subsequent changes in information requirements have caused much disappointment and dissatisfaction with attempts to supply information since the reapplication of past evaluation strategies has proved inadequate. Until recently evaluation strategies have been the stepchild of educational research. Examples of the superficial treatment of the field abound in the literature and need not be elaborated here. But, a brief review

of our changing evaluation needs will help set the context of the papers to be presented.

At the federal level, the current emphasis on program planning based upon program objectives has altered significantly the information needs of the U. S. Office of Education. This same stress on planning at the state educational agency level has been a source of friction between those who have the new needs for information and those who must provide it. Local educational agencies have also felt the impact of federal and state pressure for information and have reacted with varying degrees of compliance. Thus, as the decision maker's role in the educational structure has moved from one of stewardship of funds and programs to one of change agent through active program involvement, the educational information needs of the decision maker have also changed.

### The Context

In order to relate our current evaluation problems to the context of the decision making process, we must first structure the decision making process. From structure, the unique information requirements at each level can be more clearly understood while the role of the common elements of information across each level of the process will become more apparent. Decision making is here structured into four levels. Each level is followed by a brief description of the context and content of the level.

- I. Long range planning: At this level the goals and objectives of education are clearly stated, refined and clarified. Educational programs are examined and elaborated in relation to goals. Also, the necessary resources in terms of program requirements are estimated. This is the where we intend to go level of decision making.
- II. System structuring: At this level the decision making function centers on the structuring of and responsibility for transferring goals into working programs and the subsequent allotment of resources. This is the how we intend to get there level.
- III. System allocation: At this level decisions concerning the elements of staff, facility, finance, curriculum, pupil, and community resource allocation and sequence are made. This is the what it will cost level.
- IV. System monitoring: At this level decisions based upon information provided by the interactions of program elements are systematically gathered and presented to the relevant decision makers. This is the feedback or how we are doing level.

The four levels of decision making described above have two major areas of impact. Internally, decision makers are concerned with maintaining a high level of participation, dedication and cooperation while minimizing conflict and anxiety. Externally, decision makers weigh the effects of the organizational functioning on the many publics from the standpoint of gaining support and acceptance. Clearly, these conditions call for a continual flow of information. The current restructuring of our educational enterprise has created new needs for information.

The differential information needs at each level become even clearer when one accepts the fact that educational decisions exist

in a federal, state and local context, and have multiple external audiences which may, or may not, provide legislative and community support for the educational system.

The present problem of the evaluator is one of setting up a methodology that provides relevant information at the appropriate time for decisions at multiple levels across varied programs viewed by audiences with diverse backgrounds.

A pause for clarification. It must be understood that information systems, whether presented verbally, in printed form, pictorially, or in the form of computerized summarizations and manipulations, are only instrumentalities designed to convey meaning and intent for the facilitation of understanding. Essentially, all information systems have sources (the input), ordering, sequencing, classification, and analysis procedures (the process) and formats for displaying the processed information (the output). The point being that only chance can render an information system adequate when the decision maker does not specify, before an information system is put into operation, exactly what output is expected of the system. To the extent that this cannot be done, the system will probably be judged inadequate.

In the past, educational information typically originated in summary form and was further aggregated by district, state, and federal officials primarily for control and accounting purposes. Generally, the information was adequate for the decisions that had to be made, i.e., social bookkeeping, enforcement and regulation of local,

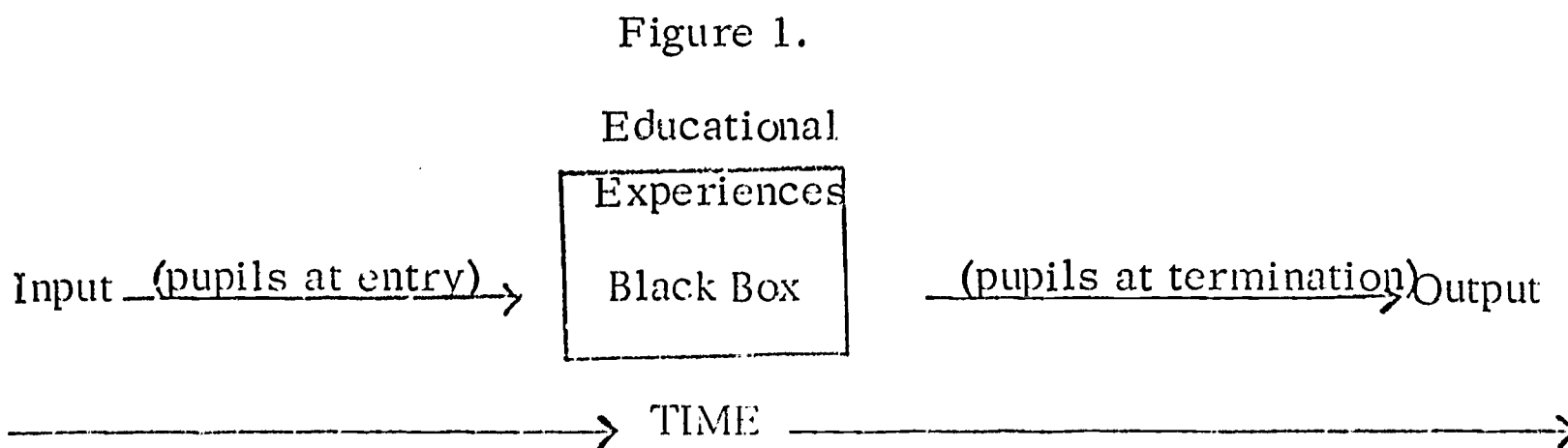


state and federal legislation and the distribution of reimbursement funds. It was after the fact data for after the fact decisions. Evaluation, as conceptualized in the past, differed from our present information system concept, centered on the learning process and was seen as separate from these information requirements. Our new emphasis views education as an integrated system with evaluation in the role of monitoring the system. This view is consistent with Weiner's work in cybernetics.

### General Systems Theory

While evaluators are accustomed to the term system as in phrases like "our educational system," their approach to problem solving typically follows the classic "statement of the problem" paradigm. A brief digression into systems theory will help establish the tone of the remainder of this chapter.

Systems theory will also clarify evaluation's role by providing a frame of reference for program development. Systems concepts and logic can begin with an oversimplified conceptualization of education as the input-black box-output analogy shown in Figure 1.



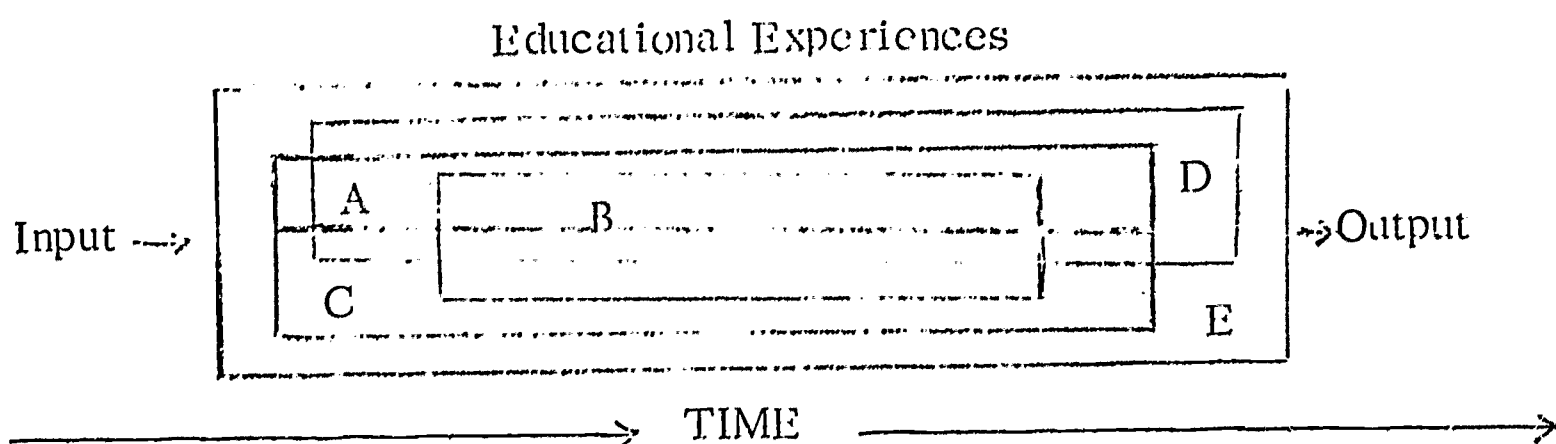
Input is here defined as the pupils entering the system.

Pupils can be further described by their sex, age, attitude, aptitude, and demographic characteristics as well as by many other factors. In systems terminology, these characteristics define the range of tolerance for the input "raw material" that enters the system. The outputs of the system (graduates, transfers, drop outs) are, in our terms, the products of the system.

The contents "black box" may be represented by five other data classification categories. Literally, the black box contains all that occurs between the input and the output. Since our concern centers on levels of decision making the contents of the box shall be examined first in terms of local program monitoring and then in terms of data requirements at the other levels. Programs within the Local Educational Agency (hereafter called L. E. A. ) can be more clearly represented by expanding the box as in a block diagram such as Figure 2. There the black box has been expanded to show the existence of information overlap or, in analysis of variance terms, confounding within and between data categories.



Figure 2.



Key

- |    |            |
|----|------------|
| A. | Curriculum |
| B. | Staff      |
| C. | Finance    |
| D. | Facility   |
| E. | Community  |

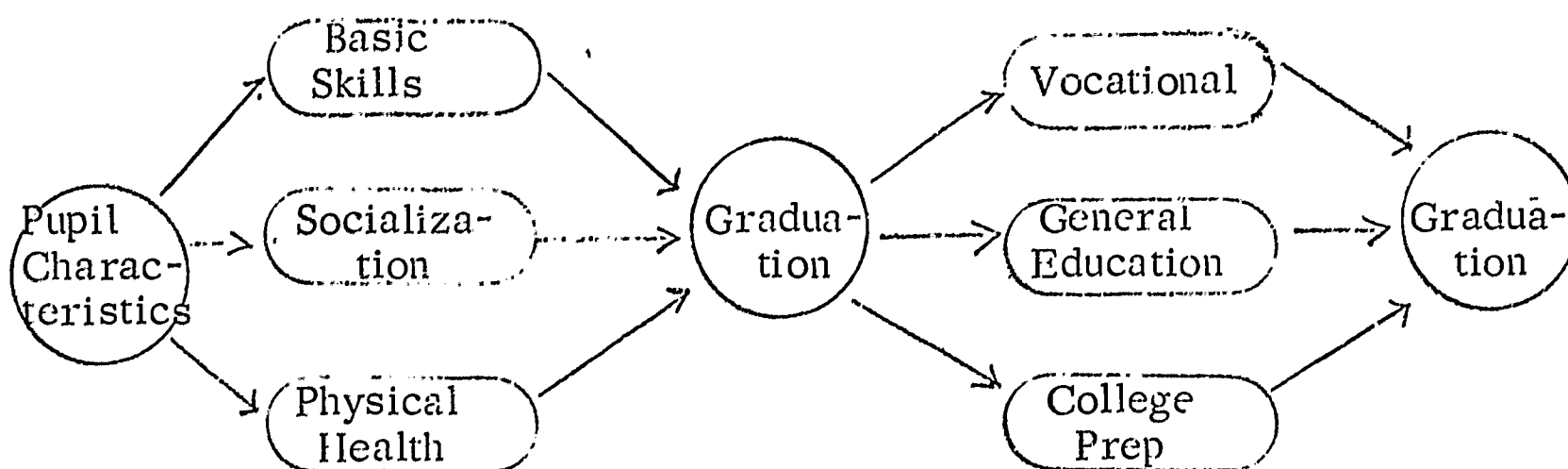
Evaluation, in terms of systems methodology, begins with an end product or outcome as a given. The delineation of desired output is analagous to decision level I on page three. The second step in the development of a methodology then consists of a series of logical steps to clarify and expand possible alternative means for reaching the output and to establish decision rules when a new alternative presents itself. The steps are successive and lead back by the expansion of alternatives to input specifications that enhance the success of the alternatives in achieving the desired end. The number and variety of the available alternatives developed through this process define the complexity of the system. Each decision alternative then represents a fork or node in the path. The nodes form the logical points for monitoring the system.

The output at each monitoring point as well as the output at the

termination of the complete system is measured against the system objectives and performance standards. The quality checks at the output of each stage serve to improve the performance of the next cycle of the system and are pictured in an oversimplified form as Figure 3.

Figure 3.

### A Simple Two Stage Educational System Model



Evaluation consists of an examination of alternative means and their related conditional probabilities at each step of the educational process given the existing or desired end. Given a statement of the end or outcome, it can be shown that movement (in the sense of defining alternate means of achieving an end) is a backward process, a continual expansion of possible alternatives and their associated probabilities. Clearly, outcome standards serve as the starting points for both the building and evaluation of existing as well as proposed programs. The paradigm holds for educational systems, missile systems and manufacturing systems. It is as useful as it is generalizable.

The key concept stated thus far was the probabilistic relationship of means to ends. In every system, the end or outcome is the result of a series of intermediate steps which have the power to alter and thus affect the occurrence of the outcome. Therefore, it is possible to conceptualize and simulate probability models of existing systems and/or proposed systems in many areas. Changes in outcome can be predicted as alternatives are selected. This statement allows us to consider each refinement of the output statements back through the system as a series of conditions, i.e., necessary and sufficient conditions but not causal conditions, which may or may not enhance the achievement of the desired output.

In other words, given a clearly defined end product, a systems theorist would proceed back through the decision points and, at each step in the procedure, define the limitations (conditional probabilities) of the possible alternatives in the described system. The simulation possibilities when this approach is applied to evaluating educational innovation are in the future, but in the near future.

The procedure stands in marked contrast to yet enhances the usefulness of the hypothesis testing model with its dichotomous accept-reject alternatives. Systems theory represents a powerful approach to the evaluation problems long associated with the assessment of educational programs. Educational evaluation exists today because of a commitment to improvement, to enhancement of outcome and to the scientific investigation of our attempts to achieve objectives. It is

here posited that educational questions such as the assessment of a particular program's impact can be best answered in terms of possible contribution to increasing the probability of occurrence of defined program outcomes.

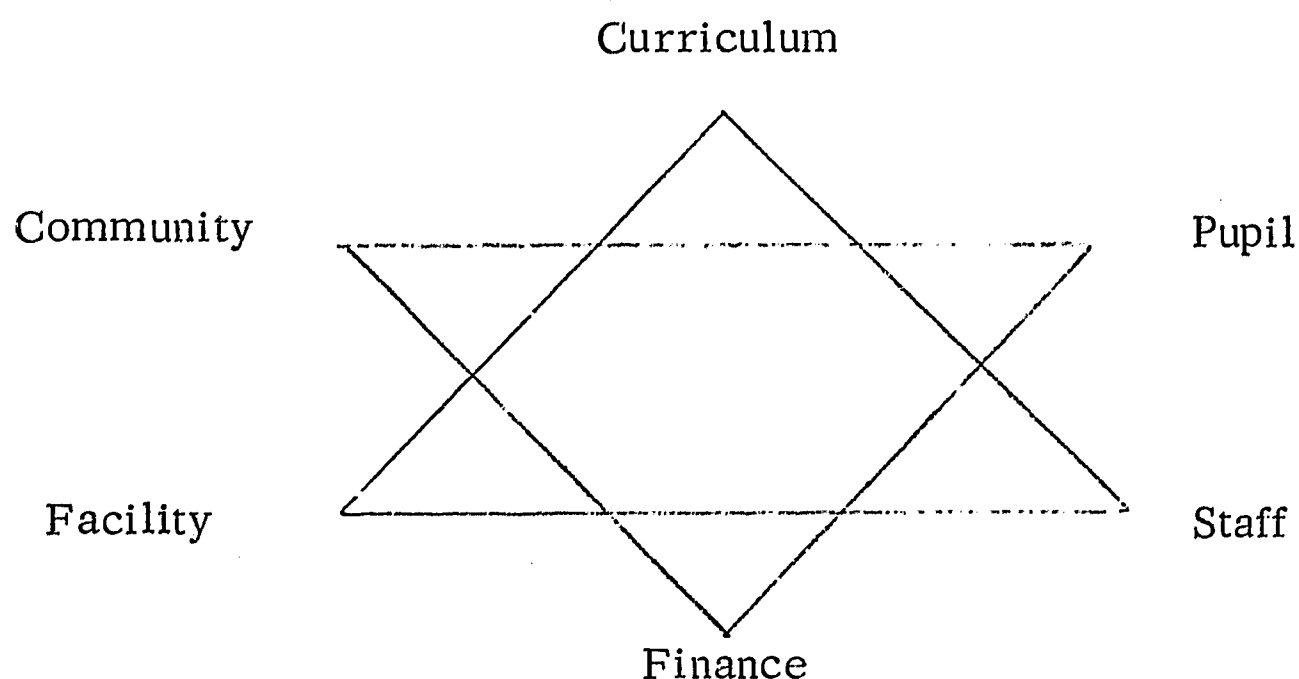
Educational questions are best answered in terms of the alternatives that exist for achieving the desired end. Each alternative then furnishes the evaluation "raw material" and is measured in terms of its contribution to the occurrence of the desired outcome.

The evaluation strategies presented here attempt to integrate information needs and present them as an evaluation product. Since education is a change process, the evaluation of education is the monitoring of the process through an information system. The thrust in evaluation demands a rethinking of our existing information structure as a first step in planning the monitoring of change. Educational information can be described by the six interrelated classification areas of curriculum, pupil, staff, finance, facility, and community.

Information from each classification area is interrelated, impinges upon the decision making process and is relevant to our problem. The author proposes an evaluation methodology that rests upon a core of data elements from each of the classification areas gathered primarily at the fourth level of decision making. The methodology has four features which are basic to meeting information requirements: 1) the provision of a base of data elements based upon common definition in each data category; 2) a comprehensive picture of the relationships

between data content across classification areas; 3) a source of information related to multiple questions across classification areas; 4) a built-in set of alternatives as to cost, practice and procedure.

Figure 4.



It is axiomatic that: 1) one cannot create information from data that are not collected; 2) one cannot create information from data that are not commonly defined; 3) one cannot anticipate all possible information needs. The interrelationships of data elements are shown in Figure 4.

#### Curriculum

Curriculum information is placed first as it represents the best indicator of the intents of our educational system. For example, one aspect of the general goal of a literate population would be a language arts strategy at level I, an organizational structure to carry out the strategy from decision level II, the further clarification of actual

courses such as third grade spelling from level III, and actual course outlines and units from level IV.

The curriculum, then, represents our best estimation of the actual content of our educational programs. It is the organizing agent in our evaluation system since the grouping of curriculum elements from educational programs reflect education's attempt to achieve the goals of our society. The six classifications represent the elements necessary for the accomplishment of program objectives. They are best thought of as correlates to program effectiveness. Common facets of curriculum include:

1. Course name
2. Mode of instruction
3. Method of presentation
4. Theory of instruction
5. Time allocation

#### Pupil

The pupil information classification system consists of data elements with common definitions in the areas of demographic characteristics, measures the present level of intellectual functioning, and measures of achievement, performance, aspiration and expectation are:

1. Demographic data
2. Present and past performance in course work
3. Test information-achievement, intelligence, attitude
4. Participation in clubs, hobbies, athletics, etc.

#### Staff

The administrative, special education, regular teaching, and consultant staff data would be included in this category. Data elements



are:

1. Demographic characteristics
2. Training and experience
3. Ratings and effectiveness measures
4. Organizational setting and characteristics
5. Salary

### Finance

Financial data related to the maintenance and operation of the educational system would be included. Including data elements such as:

1. Tax base and millage
2. Per pupil expenditures
3. Administrative overhead
4. Material and supply expenditures

### Facility

Common data elements about the facility would include :

1. The site
2. The buildings
3. The educational spaces
4. The equipment

### Community

The size and composition of the community that each school serves would fall in this data category. Typical elements are:

1. Area served
2. Principle industries
3. Principle housing types and condition
4. Income level
5. Ethnic characteristics

Six classes of interrelated information can then be created from the critical data elements from the categories. An evaluation design,

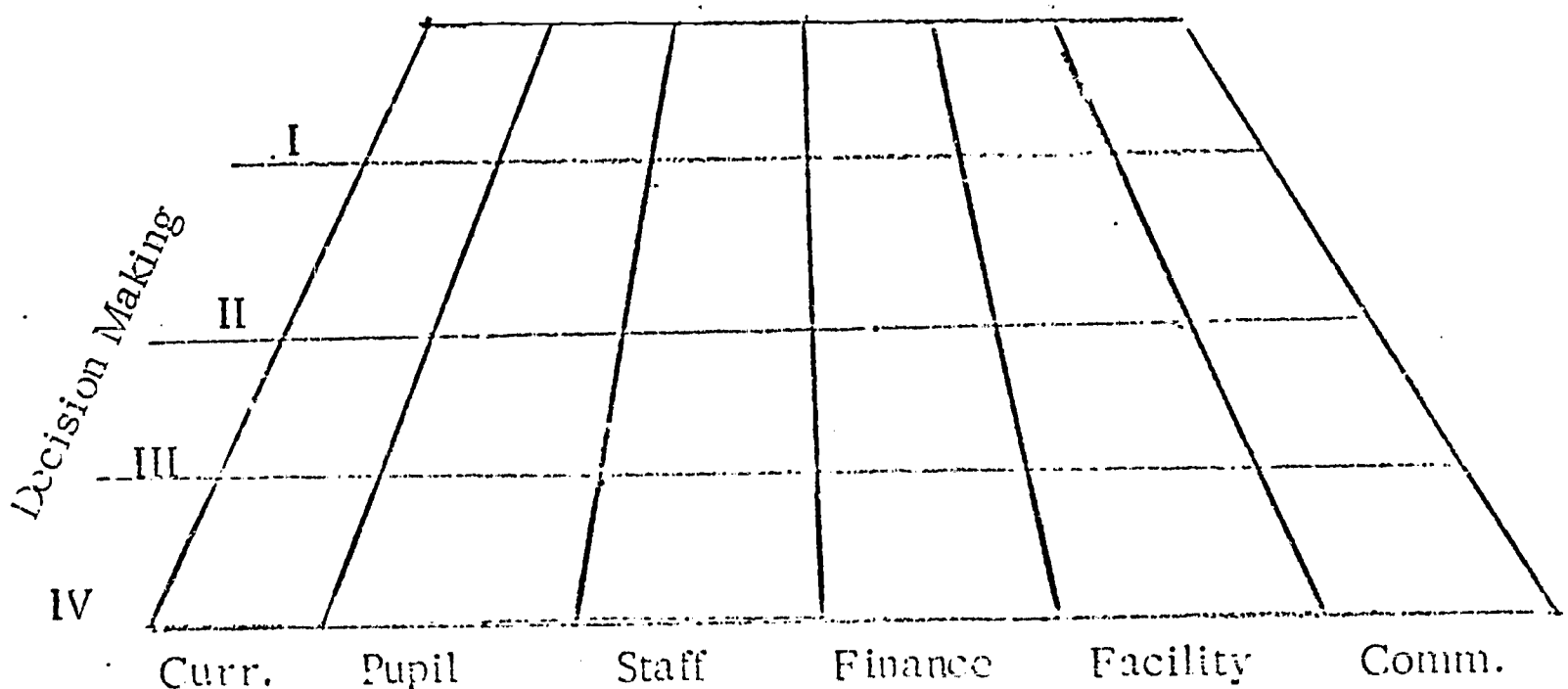
at least from the standpoint of generalization from a process paradigm, would have access to these elements.

A great deal of work has already been done by the U. S. Office of Education on the taxonomy problem for data element definition through the handbook series. This effort has centered upon common and standard usage of terminology in education; or, if you will, a common classification and definition of data elements. The Iowa Educational Information Center has also developed many techniques for interrelating data elements from the six classification areas. By capitalizing on this work, evaluators are now in the position of being able to employ data elements that have common definitions across projects, at least at the level of specificity necessary for data aggregation and summarization necessary in program comparisons.

#### Educational Programs

The goals of American education are reflected in our educational programs, each program represents our operationalization of these goals and can be specified under the classification schema.

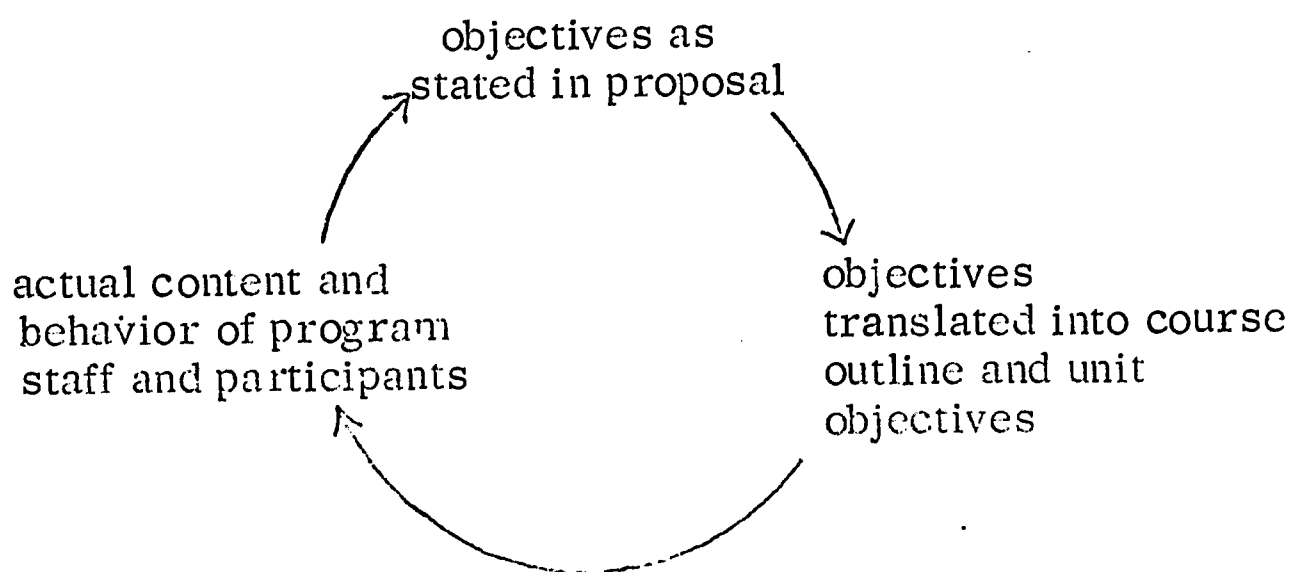
Figure 5.



The information structure necessary to monitor these programs takes the form of a truncated pyramid as shown in Figure 5. The figure is truncated to represent the restriction placed upon data elements in each classification category when data is transformed into information at each level in the hierarchy.

The evaluation process at the level of project monitoring is best described as consisting of at least two dimensions. The first is time. The time sequence consists of clearly stated (in behavioral terms) expected outcomes as written into a proposal, the expected interactions leading to the outcomes as defined by those staff members involved in the proposal operation, independent observations of the actual content and interactions of the program and assessment procedures for describing progress toward the achievement of project objectives. It is sequential in that one step follows the other. It is cyclical in that the process iterates itself until what is actually happening in the program is congruent with the stated implicit and explicit objectives. The process can be shown graphically as in Figure 6.

Figure 6.



The process evaluation can be conducted as a series of questions which culminate in decision rules. From the written statement of objectives, one asks the questions of definition of terms, internal consistency, level of specificity and assessment procedures for the achievement of stated objectives. These questions can be simply stated. "Is this where you want to be at the end of the program?" "How will you know that you have arrived there?"

The second step also consists of a series of inquiries into the formulated procedures and interactions intended to achieve the objectives and assess progress as they are envisioned by the staff of the program. This is usually the statement of behavioral objectives at the levels of course outline, specific units, and the measurement devices intended to assess the behaviors.

The common elements of the program monitoring level as evaluative information must meet the criteria of common definition of descriptive terms, specified collection times, classification ties, and fidelity in relation to each of the six categories specified.

This is an appropriate point to introduce the problem of information specificity as it relates to level of decision making, i. e., the problem of fidelity. Our basic proposition thus far has been that of the existence of multiple decision makers. Second, we have asserted that decision making can be conceptualized into four levels. Third, data elements exist in six related classification areas which can be put together in various ways to form information. Fourth, our

educational system can be divided into program areas that have information requirements. And, finally, the decision making process consists of a series of confrontations between intents, procedures and outcomes until a satisfactory state of congruity is reached. All of these propositions come together in relation to the question of fidelity.

Shannon has demonstrated that fidelity (the undistorted inclusion of all data) is related to bandwidth (the space available for data communication at any one time) in that an increase in bandwidth can only be purchased at the cost of fidelity. The converse is also true. When these maxims are placed in the evaluation methodology context, the data aggregation problem is clarified.

Complete (high fidelity) information from one project when shown in aggregate form with all other project reports represents a wide bandwidth report. Individual project fidelity is lost in this process. It is the failure to realize that there is an information loss inherent in the aggregation of data that has caused problems in state and federal reporting procedures. Every time a summarization and reordering of data elements are necessary for the next level of the decision tree, a loss of individual project fidelity occurs.

In our educational structure, decision levels are imbedded in educational programs. Decisions related to each program, in turn, subsume data elements from combinations of the six classes of information across decision levels in order to produce relevant and timely information. To summarize, we have viewed four levels of

decision making evolving from the transformation of national goals into educational programs. The evaluation concepts outlined enhance the necessary program decisions by the production and presentation of relevant and timely information gleaned from data elements of the six classification categories.



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